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The concentration of the activator is the most important factor in determining the amount of this intensity. The investigations of a number of authors disclosed an optimum concentration (4). The data we obtained also confirms this fact. This data is represented in Figure 1, where the logarithm of activator concentration is placed along the axis of the abscissa (X-axis) and the equilibrium intensity of the corresponding phosphorus is placed along the axis of the ordinate (Y-axis).

As seen from this diagram, the region of optimum concentrations differs substantially for activators. For activators Fe, Co, and Ni, optimum concentration is 10^{-7} to 10^{-6} gram per gram of ZnS; for Ag and Cu it is 10^{-5} to 10^{-4} gram per gram of ZnS; and for Mn it is around 10^{-3} to 10^{-2} gram per gram of ZnS.

All the curves go higher for the ZnS components which annealed at a temperature of 900 degrees centigrade than they do for components with an annealing point of 1,200 degrees centigrade, although the value of the optimum concentration is essentially maintained. The curve for the copper activator clearly exhibits asymmetry: the drop of intensity in the region of large concentrations is a little sharper than the rise in the region of small concentrations. Of all the composites examined, copper yields "alloy" composites of the greatest intensity.

Composites prepared with two activators had a lower glow intensity than those prepared with just one activator, although the interaction of the activators in the various cases proceeded differently: silver added in the quantity of 10^{-4} gram per gram hardly weakened the glow of the ZnS-Cu composite, while an addition of manganese in the quantity of 10^{-3} gram per gram produced a noticeable extinguishing of this composite's luminescence. The extinguishing action of increments of metals in the ferrous group on luminescence was detected even more sharply. Here, an appreciable extinguishing of the composite's luminescence was observed even during the addition of the second activator in a concentration of 10^{-6} to 10^{-5} gram per gram, while cobalt, of all this group extinguished the glow most intensively. The interaction of activators and spectral distribution of radiation energy is graphically noted on the curves.

The spectral distribution of intensity is determined by the spectrometer constructed by M. N. Alentsev in the Physics Institute, Academy of Sciences USSR. The conditions of excitation were the same as those during measurement of visual intensity. The results for luminous composites, with various activators and their combinations, are presented in the diagrams. Figure 2 gives the luminescence spectrum of pure ZnS (ZnS.Zn) for various annealing temperatures of the composite. Figures 2 and 3 are the spectra of composites in which only one activator, in varying concentrations, was introduced; here the annealing temperature was 1,200 degrees centigrade, except for the composites ZnS.Cu and ZnS.Mn where it was 900 degrees. The spectra of composites containing various combinations of the activators at annealing temperature 1,200 degrees is shown in Figure 4.

Zinc's own characteristic line is clearly visible in composites which were annealed at 900 degrees centigrade. It became weak in composites which were annealed at higher temperatures (1,100-1,200 degrees centigrade). In the ZnS.Cu and ZnS.Mn luminophors, the zinc signature line became very weak with an increase in Cu and Mn concentration. Thus, the zinc line is suppressed by the annealing temperature and the second activator (5). As a rule, the maximum position for the spectral lines corresponding to the separate activators does not depend on the annealing temperature. For ZnS.Cu composites, the glow-line maximum shifts towards short waves with large quantities of the activator, which increase the optimum value of its concentration substantially. With the addition of other activators to the ZnS.Cu composite, the luminescence spectrum of the composites obtained is characterized by the copper line, whose intensity decreases with an increase in the concentration of the additional activator.

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Investigation of the spectral curves shows that during the introduction of several activators in the luminophore, a complex interaction takes place.

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[Appended figures follow.]

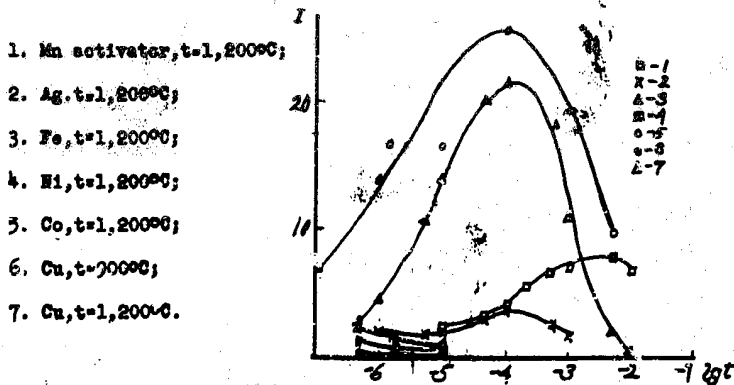


Figure 1. Dependence of Total Intensity of ZnS Luminophors on Activator Concentration for Various Activators

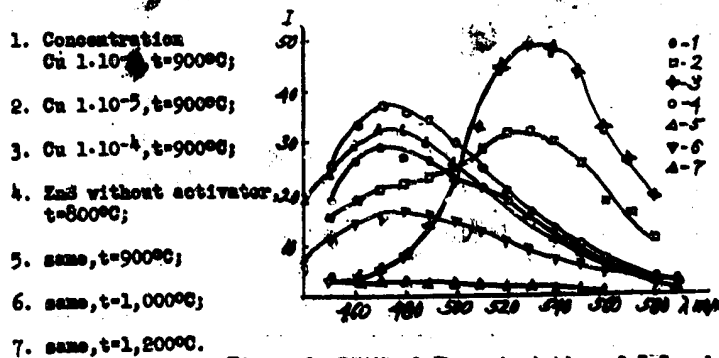
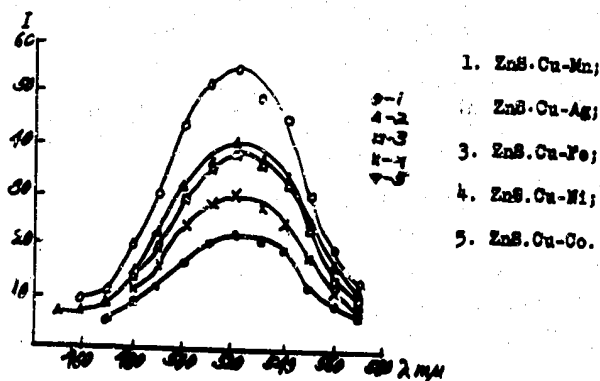
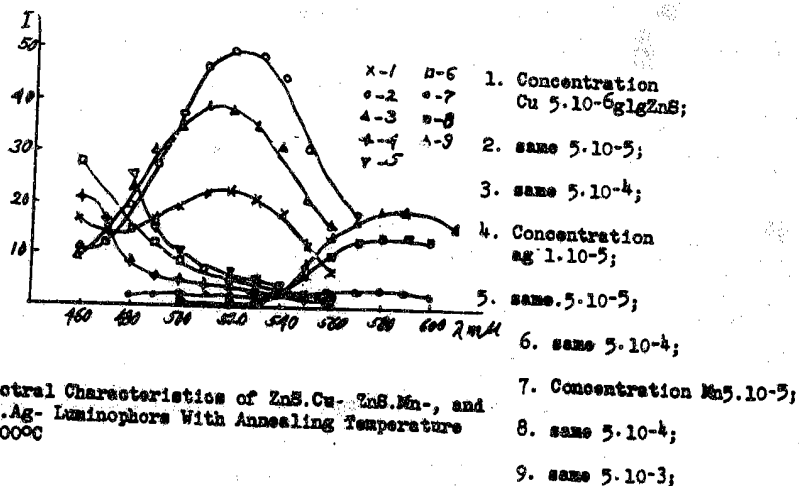


Figure 2. Spectral Characteristics of ZnS and ZnS.Cu Luminophors For Various Annealing Temperatures

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